

or
$$\delta = 1 + \frac{v}{V} \quad \text{or} \quad = \frac{V+v}{V}$$

A very simple formula, in which the original number of waves disappears, showing that the interval between the two notes is irrespective of the original pitch of the whistle, and depends only on the velocity with which the listener approaches the source of the sound.

We have now to take the case where the listener, having passed the whistle, is receding from the source of sound. The note will then appear flatter than the real one, and its vibration number will be found by the same rule as before, merely giving v a minus sign.

$$= n \left(1 - \frac{v}{V} \right)$$

And the *interval*, i.e., the ratio of the vibrations of the higher to that of the lower, denoted by δ_1 will be

$$\delta_1 = \frac{n}{n \left(1 - \frac{v}{V} \right)} = \frac{V}{V-v}$$

These two intervals added together will express the *drop* of pitch of the whistle at the time of passing.

But to add intervals together we must multiply their ratios; hence if δ_2 represent the drop,

$$\delta_2 = \frac{V+v}{V-v}$$

from which the drop of the whistle corresponding to any speed may be found.

To simplify the reasoning, we have supposed the whistle to be stationary and the listener to move with a velocity $= v$. If both move, as is the usual case in railway trains meeting, v must be made = the sum of the speed of the two.

Taking $V = 1120$ feet per second for ordinary conditions, the following table shows the value of the *drop* for different speeds:—

| Conjoint speed of the two meeting trains. | | | | Corresponding drop of the note of the whistle. |
|---|-----|------------------|-----|--|
| Miles per hour. | | Feet per second. | | |
| 24 | ... | 34 | ... | A semitone $\left(\frac{16}{15} \right)$ |
| 45 | ... | 66 | ... | A whole tone $\left(\frac{9}{8} \right)$ |
| 70 | ... | 102 | ... | A minor third $\left(\frac{6}{5} \right)$ |
| 85 | ... | 125 | ... | A major third $\left(\frac{5}{4} \right)$ |
| 108 | ... | 160 | ... | A fourth $\left(\frac{4}{3} \right)$ |
| 152 | ... | 224 | ... | A fifth $\left(\frac{3}{2} \right)$ |

I have made observations whenever I have had the opportunity, and find the results corroborate the deductions of theory. The most common interval observed in ordinary travelling is about a third, major or minor, corresponding to a speed of between thirty-five and forty miles per hour for each train. W. POLE

GLASGOW SCIENCE LECTURES

UNDER the title of the Glasgow Science Lectures Association, an organisation has lately been formed in Glasgow, whose object is to provide annual courses of

lectures on various branches of science by men of eminence in each department, so as to place in clear and comprehensive outlines the most important results of scientific inquiry before the public of Glasgow, and at such a rate as will secure to those who cannot otherwise obtain it the best information on the state of science, as established by the most recent investigations of its most distinguished workers. The scheme originated amongst a number of working men who were desirous of following the example of the science lecture movement which has been so successfully worked out in Manchester during the last six or seven years, but with this difference, namely, that the lectures should be self-supporting. To accomplish that end, and be in a position to pay the lecturers liberally for their services, they at once saw that the minimum rate of admission could not well be fixed at less than threepence, and they confidently believed that many of their fellows would be most willing to pay that amount for the privilege which it was proposed to place within their reach. They soon enlisted the sympathies and active co-operation of persons in a higher social sphere, and in due time the Association took active shape. A large executive committee was constituted, and Dr. Allen Thomson, F.R.S., one of the most distinguished members of the professorial staff of the University of Glasgow, cheerfully accepted the honorary presidentship of the Association, while a number of other prominent citizens were enrolled in the list of vice-presidents.

Owing to the fact that Prof. Roscoe had been the moving spirit of the Manchester Science Lectures for the People, he was very early communicated with, in the confident hope that valuable advice based upon his practical experience would readily be placed at the service of the originators of the Glasgow lecture scheme. They were not disappointed in their expectations, and, indeed, had they been lacking in enthusiasm and determination to make the scheme a success, they would have been stimulated to action by the various communications which they received from that gentleman.

It was very late in the past year before the Glasgow Science Lectures Association was sufficiently well organised to make any public announcement of its existence; but the active promoters of the movement were most anxious not to allow the whole winter to pass without having some lectures delivered under the auspices of the Association, no matter how short the course might be. Prof. Roscoe most kindly and cheerfully consented to take part in the first or introductory course; and considering that gentleman's peculiar relationship to the Manchester Science Lectures, the committee came to the conclusion that no person could more appropriately assist at the public inauguration of the movement in Glasgow. Accordingly, with his consent, Prof. Roscoe was set down to deliver the opening lecture of the introductory course, and other three distinguished men of science were selected to follow him, namely, Sir William Thomson, Dr. W. B. Carpenter, and Prof. W. C. Williamson, of Owens College, Manchester.

The inaugural lecture was delivered on the evening of Friday, the 8th of January, and it was in every sense a most auspicious beginning. The Glasgow City Hall was chosen as the place for the delivery of the lectures, as the committee were desirous of bringing together the largest audiences that could be convened in any place of public meeting. It holds well-nigh three thousand persons, and on the occasion in question it was crowded. The reception given to the eminent lecturer was most enthusiastic. Dr. Thomson occupied the chair, and in introducing Prof. Roscoe to the meeting and formally opening the first course of lectures, he delivered an exceedingly valuable address, in the course of which he justified the formation of such associations as the one under whose auspices the lectures were to be given. He said that he had no doubt that in the selection of the lecturers the committee of the

Association would always keep in view the possession by the lecturers of those qualities which alone could secure ultimate success in their enterprise, and which might be summed up as follows:—First, the fulness of knowledge which belongs to an accomplished master of his subject; second, the authority in statement which is derived from original research; and third, the disposition and power to convey full and accurate information to others with simplicity and clearness.

The subject of Prof. Roscoe's lecture was "The History of the Chemical Elements," and it was most completely and successfully illustrated, especially in the department of spectrum analysis.

Sir William Thomson's lecture will be on "The Tides," in which it is expected that a full exposition will be given of the more important results arrived at by the British Association Tidal Committee in their recent investigations.

Dr. Carpenter has chosen as his subject "Man not an Automaton," with reference to the recent lectures of Professors Huxley and Clifford; and the concluding lecture, by Prof. W. C. Williamson, will be on "The Dawn of Animal Life."

It is the intention of the committee in future sessions to provide courses of eight or ten lectures, embracing all those branches of science that are susceptible of being treated thoroughly before large and miscellaneous audiences. What the public now want is lectures of the highest class, conveying ample information, but without unnecessary technicality and learned difficulty. The success of the Manchester Science Lectures for the People and of the lectures delivered to the working men in the towns visited by the British Association during recent years, abundantly shows that such a desire is yearly becoming more and more prevalent. JOHN MAYER

ATLANTIC NOTES

Migration of Birds—The Thresher and Whale

IN crossing the Atlantic last September, when 900 miles distant from the nearest point of Newfoundland, two land birds settled on the ship, and after a short rest resumed their flight to the south-east, without partaking of the food which was scattered in various places for them. By the colour of their plumage and motion on the wing, I believe them to be a species of lark. It may well be asked whence did they come, and whither were they going over that vast space of ocean, with no resting-place nearer the continent than the Azores? How were they fed during their long journey, and what guided them on their course? for it is only reasonable to suppose they had come on a bee line from their starting point, and even then their muscular powers must have been severely taxed. It appears to me that naturalists are not in possession of the secret which enables birds of passage to go many days without food at a time when their system must be strained to its extreme limit of endurance.

From the result of close observation, I do not believe that land birds are often, if ever, driven to sea by the force of the wind. Some other cause must influence their movements. At the head of the Gulf of Bothnia, when there has not been a storm for many days, I have seen scores of different species around the ship, amongst them the hawk, the owl, the robin, and many others. Are those who alight and stay by the ship the stragglers from the ranks of the armies which annually migrate, the sick and worn who fall out by the roadside to die, whose end in creation has been fulfilled, and their places ready to be taken by the young and strong? This surmise is strengthened by the fact that no care can preserve the lives of these tired birds in captivity; the hawk and dove alike refuse food, and quickly pine and die.

Birds must possess strong affections, as they are always

seen in pairs on these long journeys, which is an additional argument in favour of their voluntary flight over the ocean. It is scarcely possible they could remain together in a gale sufficiently powerful to blow them off the land, and more unreasonable still to imagine that the strength which is able to carry them hundreds of miles without a rest should fail to breast an ordinary gale under the shelter of the land. Such facts as these vouch for the facility with which the most remote islands may increase the number of their species without the agency of man.

Off Youghal a gigantic thresher (*Squalus vulpecula*) was passed. It was leaping lazily and obliquely from the water, and after attaining its highest altitude, fell heavily on the surface, without making any effort to ease or guide its descent. This fish was not under fourteen feet in length; the belly of a pearly whiteness, and the back marked across with broad black bands. I have never seen this fish north before; but on the whaling grounds of the southern seas it is common. I do not believe it is dangerous to the life of the whale, as is often stated, but am under the impression that the irritation caused by the attacks of the thresher makes the animal vomit up the squid and other small matter on which it feeds. It is not reasonable to suppose that the blows inflicted by so small an instrument as the thresher's tail can have much effect through a foot of blubber. The whale has also many ways of escaping from its puny enemy; he dives to a depth where the thresher cannot follow, and if he could, his power of inflicting injury would be gone, owing to the resistance caused by the water; his speed also enables him to escape at all times. The treaty of offence which is said to exist between the thresher and sword-fish appears to me to be very mythical. When the whale is sick or dying, he is doubtless an object of attack to all the shark species, as they wage war with the whaler for the coveted blubber.

WM. W. KIDDLE

THE TRANSIT OF VENUS

THE *Times* of yesterday contains some additional news from the Transit parties, specially those of France and Italy.

The French news consists of telegrams from Shanghai in the Northern and from New Caledonia in the Southern Hemisphere. From the former station M. Fleuriais, the astronomer in charge at Peking, now states that he was fortunate enough to observe all the four contacts, and not two only, as was at first stated. The times were as follows in local mean time:—First contact, 21h. 32m. 42s.; second, 22h.; third, 1h. 50m. 15s.; fourth, 2h. 17m. 13s. Nor is this all; no less than sixty photographs were taken which M. Fleuriais pronounces good. We have already stated that stations in Northern China are most useful for the application of the Halleyan and direct methods. From New Caledonia the best part of the news refers to the photographic operations, 100 good photographs being secured. Of the contacts, only the interior one at ingress was observed.

The news of the doings of the Italians comes from the party in Bengal, in charge of the distinguished spectroscopist Tacchini, including Dorna, Lafont, Morso, Abetti, and Tacchini. The telegram comes from Maddapore, and the party evidently occupied two stations. The first three observed all four contacts, the last two only the third and fourth.

As before stated, the chief instrument employed by the Italians was the spectroscope—an instrument not recognised in the equipment of any of the English parties.

The observations were of the most satisfactory kind, and the results may lead to a most important discovery in solar physics. The time of interior contact at egress was observed with the most rigorous exactness, both by the